Safe intervention: Remotely Piloted Safety Cones & Aircraft System

SESSION 6: Safe intervention

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Final Event

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Objectives

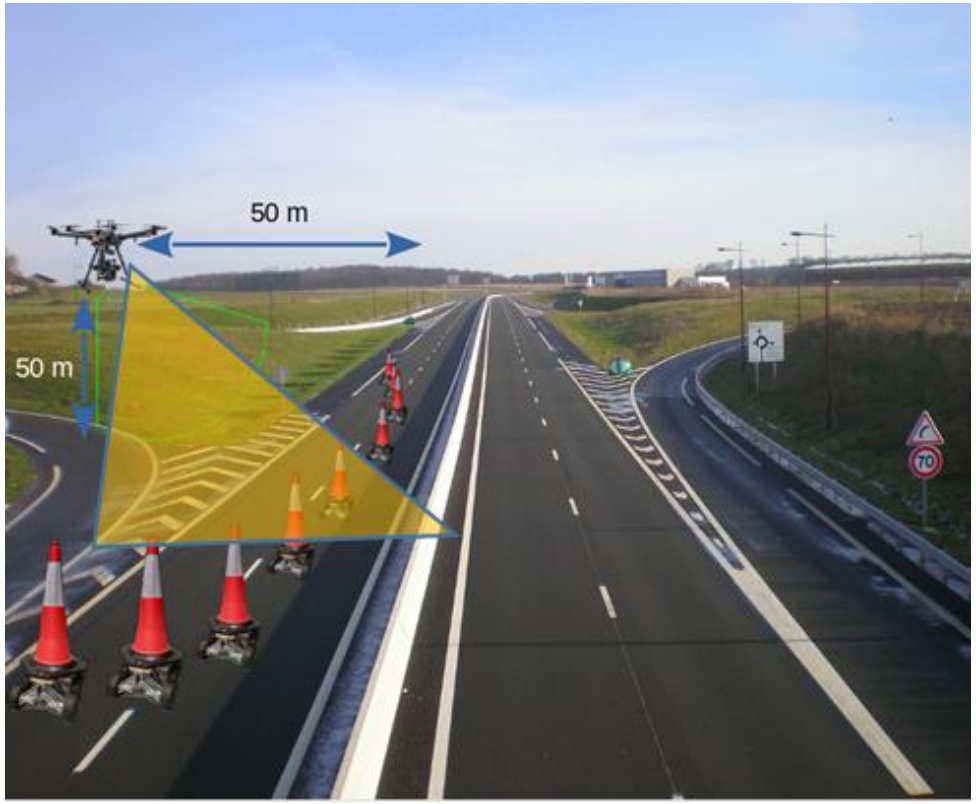
Context & Objectives

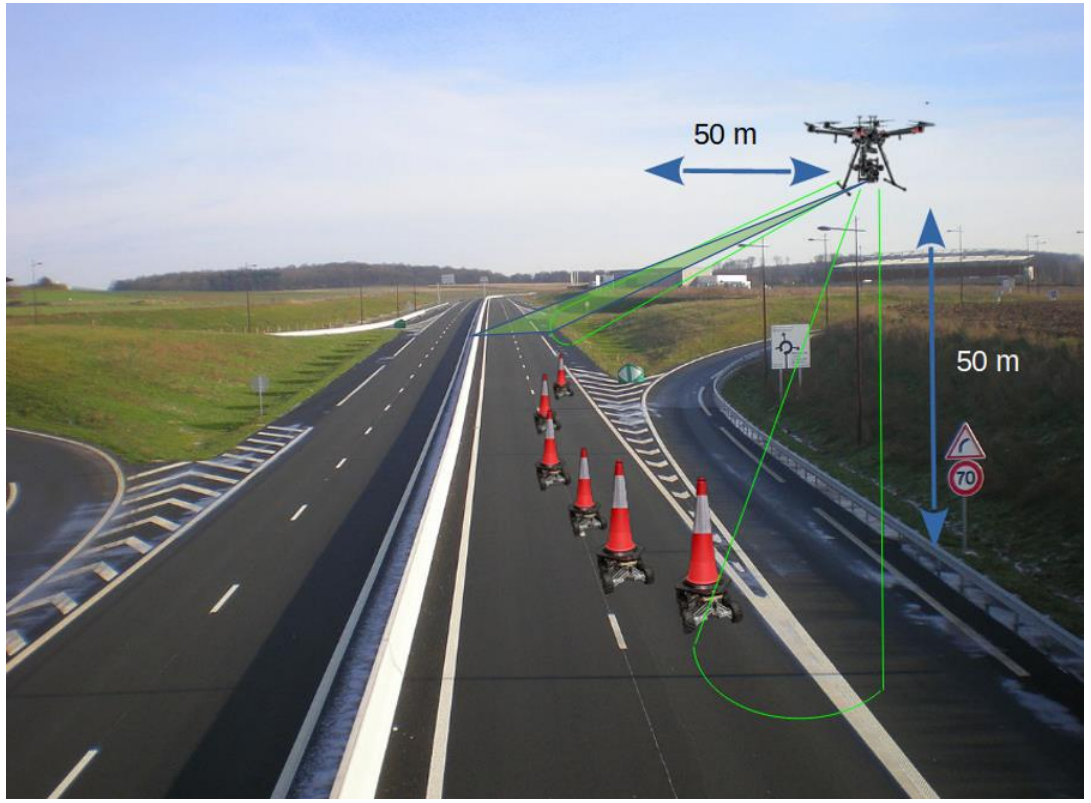
- According to National Institute for Occupational Safety and Health, 18% of construction fatalities are due to road accidents.
- According to data from the Spanish National Registry of Victims of Traffic Accidents, in 2021 there were 158 accidents related to road maintenance and conservation works, of which 17 involved workers who were working at the time.
- Two most influential factors are speeding and distractions of road users.
- [illegible] road fatalities in Austria (https://www.kfv.at/ablenkung/) and a 31% in Spain (EC Report on Fatal Crashes, 2024)

A new concept of **collaborative operation between land safety cone robots and RPAS** for enhanced **work zone segmentation and signalling** addressing both road users (drivers) and maintenance personnel (workers) building on new **AI algorithms for unsupervised monitoring of safety conditions in Work Zones**.

System Overview

System Overview: From Design…





…To implementation: RPAS Features

- RPAS Extended Operation
- Asset Localisation
- RPSC deployment assessment
- AI-Based on-the-edge monitoring system

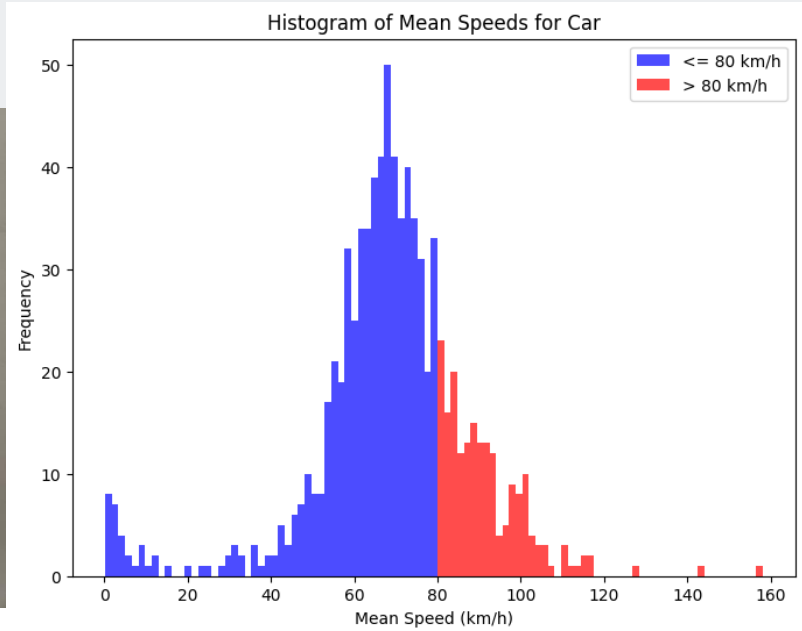
RPSC Features:
Collaborative Robotics and Alert System

Work Zone segmentation

Alert sub-system

Research Outcomes

Research outcomes



- **System Integration**
  - Tethering system for continuous operation monitoring
  - GPU-based computing system for AI
  - Normative and regulation
- **Real-time Detection and Tracking**
  - Improved AI performance up to 90 fps
  - Higher resolution on state-of-the-art Deep Learning algorithms
  - Better estimation of hyperparameters for training and improved accuracy metrics

Research outcomes

```
[INFO] [master-1]: process started with pid [15451]
[master-1] [INFO] [1730841946.582005435] [master]: Initializing master node...
[master-1] [INFO] [1730841946.596252705] [master]: The UTM zone 33 has been automatically selected.
[master-1] [INFO] [1730841946.613818960] [master]: Master node initialized!
[master-1] [INFO] [1730841954.021679328] [master]: Vehicle 347 speeding at 27.06 m/s
[master-1] [INFO] [1730841957.690416096] [master]: Vehicle 354 speeding at 28.11 m/s
[master-1] [INFO] [1730841960.121440514] [master]: Vehicle 355 speeding at 25.00 m/s
[master-1] [INFO] [1730841960.424056423] [master]: Vehicle 360 speeding at 30.19 m/s
[master-1] [INFO] [1730841960.486766923] [master]: Crash risk identified between vehicles 347 and 357. TTC: 0.48 s, DRAC: 12.26 ms^-2
[master-1] [INFO] [1730841966.930228650] [master]: Vehicle 367 speeding at 27.49 m/s
[master-1] [INFO] [1730841973.369159675] [master]: Vehicle 387 speeding at 27.72 m/s
```

- **Safety Measures and Alerts**
  - Calculation of trajectory-based Surrogate Safety Measures (SSMs) for Real-Time Alerts
- **System Orchestration (GEOCore)**
  - Simulation of Machinery and Traffic
  - Connectivity with External Machinery
  - Synchronization based on global time-stamping
  - Integration with RSU to alert users through V2X comms.

Conclusions & Future Trends

Conclusion

We **improve safety** by reducing workers' exposure to live traffic and ameliorate users' awareness in Work Zones through a system based on **three pillars**:

- Work Zone Signalling based on robotized safety cones
- Extended autonomy operation based on tethered drones
- A powerful Software for Real-Time context-analysis and alerting based on:
  - On-the-edge image analysis based on AI
  - Collaborative operation through the orchestration system GEOCore.

Future trends

- TRL improvements
- Application to Mobility Safety in Smart Cities
- Deepen Integration of Simulation to predict conflicts

Thank you for your attention

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Infra ROB

Maintaining integrity, performance and safety of the road infrastructure through autonomous robotized solutions and modularization

Project Partners

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